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McAlpine Lock Closure and Emergency Repairs 9-19 August 2004

Peter W. Frick, PE

Lock & Dam Emergency Repairs Workshop
Vicksburg, MS
19 April 2006

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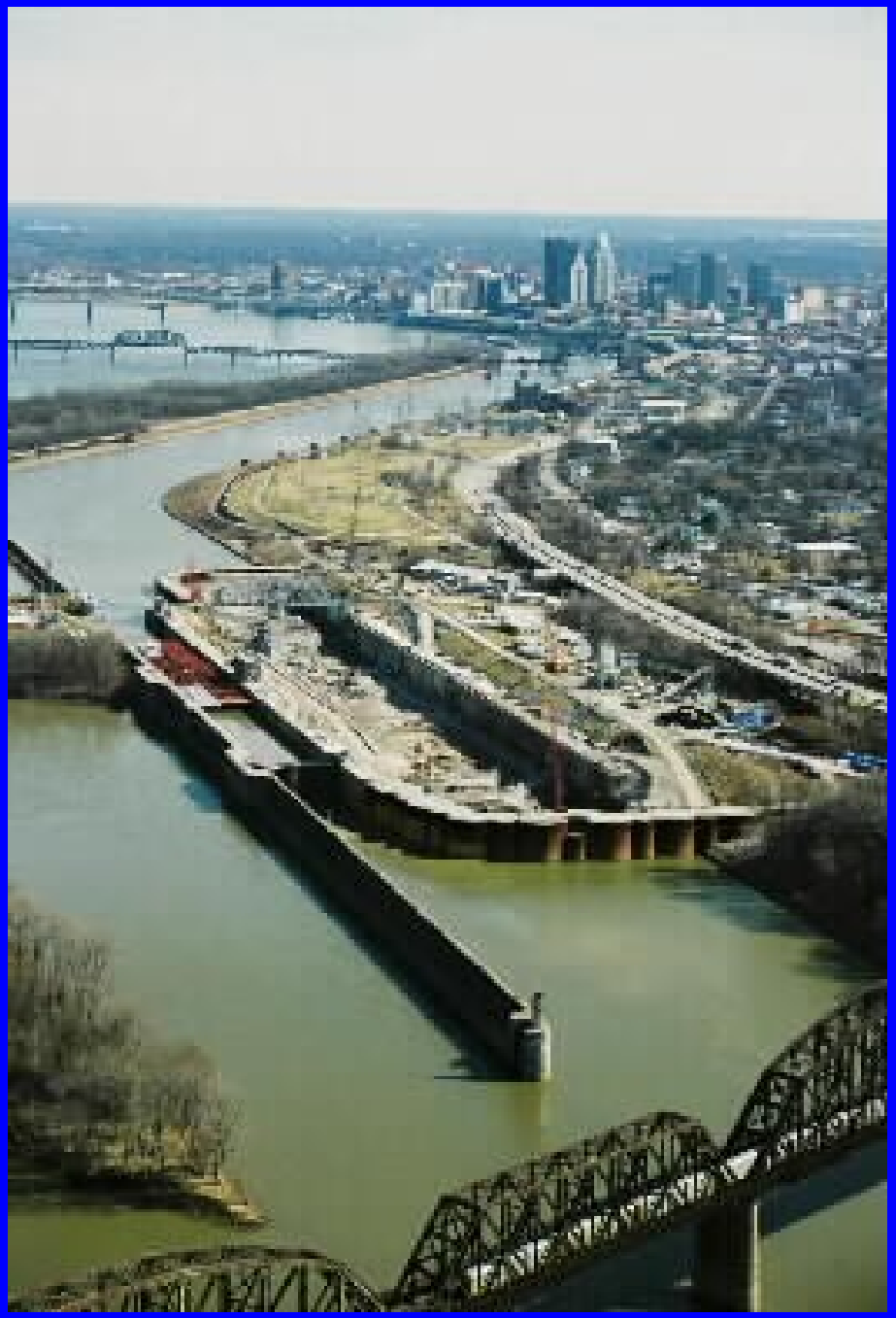
Project Overview



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Historical Background

- McAlpine lock chamber construction required demolition of the antiquated auxiliary chamber.
- This leaves it as only Ohio River lock project with no auxiliary chamber.
- McAlpine main chamber closure =

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Historical Background

- Industry supported this plan, contingent upon preventive maintenance performed to chamber immediately before construction, and availability of gate lift capability and standby gates.

- Extensive major maintenance performed prior to demolition of auxiliary.

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Historical Background

- May 2000, Award of cofferdam construction and lock demolition contract.
- Estimated new lock completion date, at that time, was 2006 – 2007.
- Now estimated from 2008 – 2010.

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Gate Problems

- Greenup and Markland History.
  - Leads to conclusion that going without a dewatering 9 yrs. or longer at McAlpine (1999 – 2008) not prudent.
  - Led to more frequent dive inspections at McAlpine.

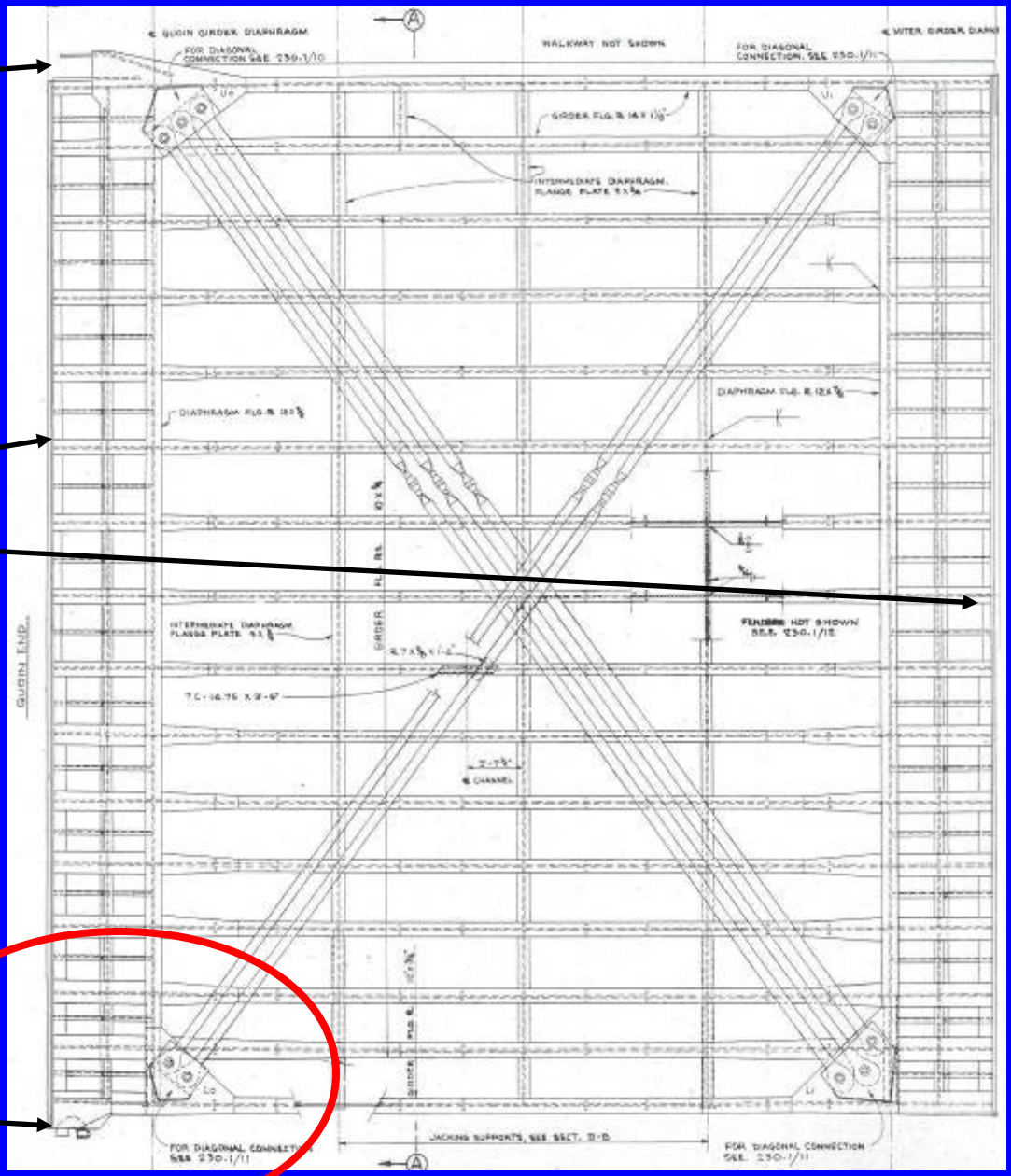
The Problems

Gudgeon Pin & Anchorage

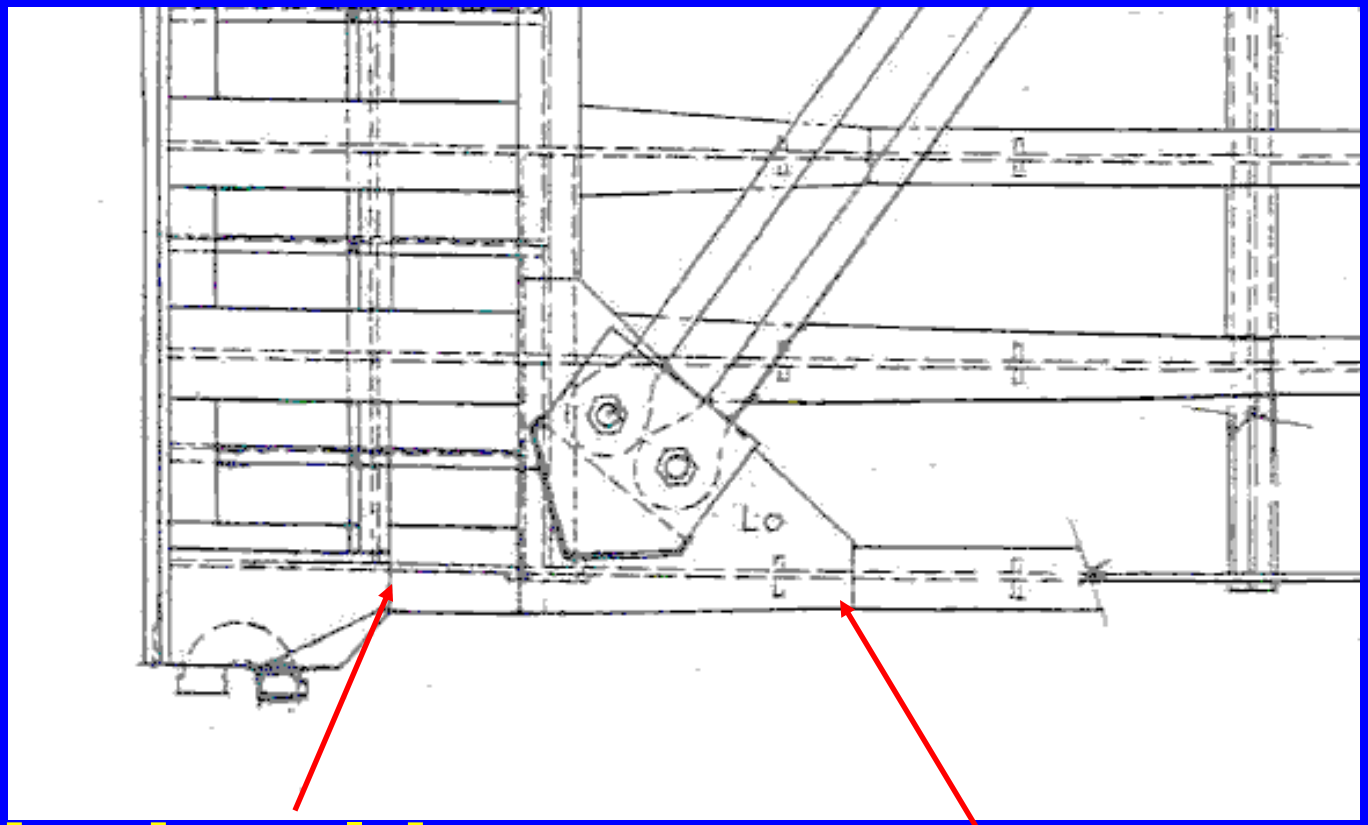
Quion Blocks
Miter Blocks

Problem Area

Pintle



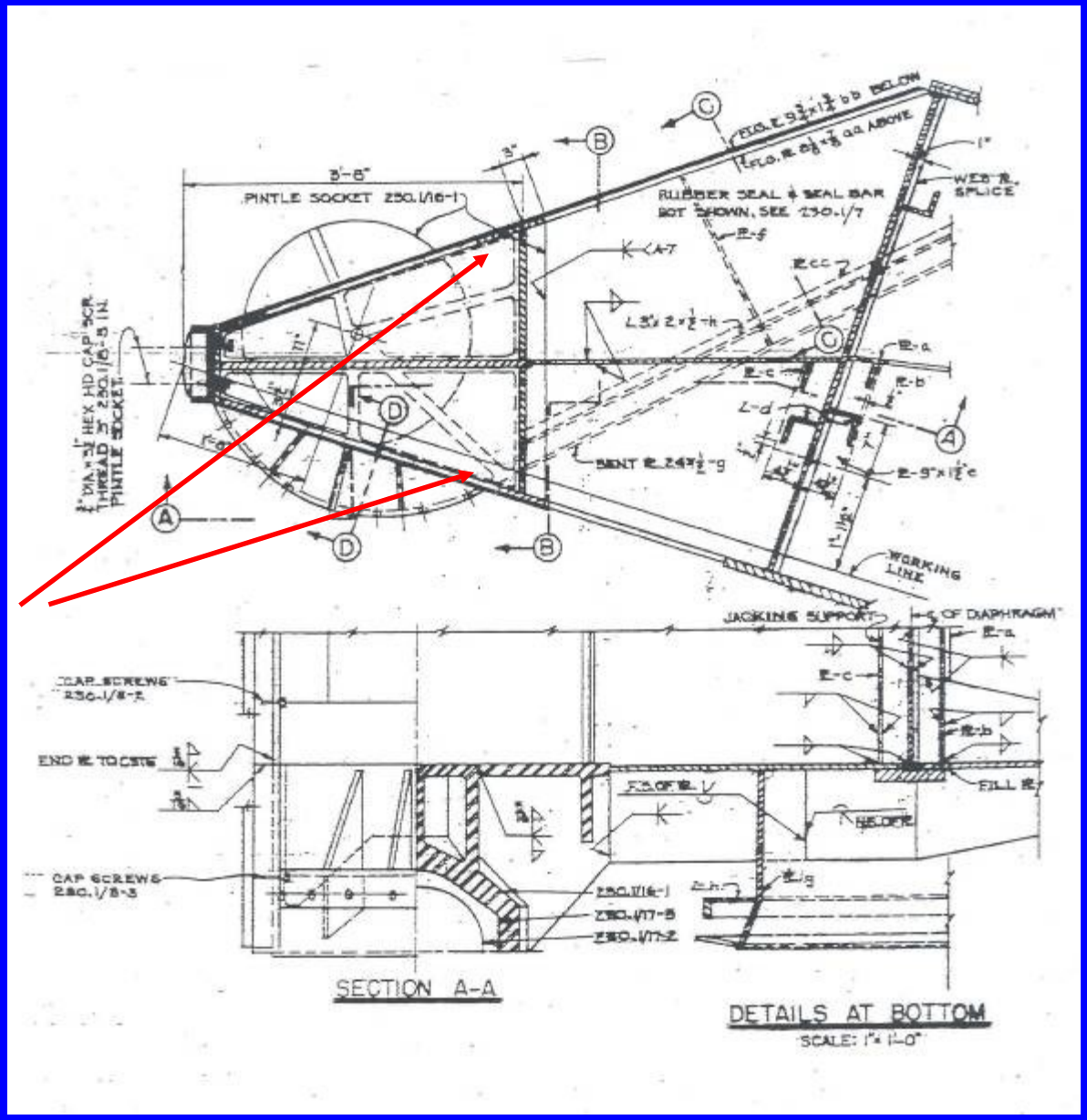
The Problems



Cracked welds at pintle socket connection to gate

Cracked welds across girder flange and web

Cracks


PINTLE SOCKET 230.1/16-1
RUBBER SEAL & SEAL BAR
WEB PL. SPLICE
WORKING LINE
JACKING SUPPORT
CAP SCREWS 230.1/8-2
END PL TO CSTG
CAP SCREWS 230.1/8-3
SECTION A-A
DETAILS AT BOTTOM
SCALE: 1" = 1'-0"

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Why were emergency repair and lock closure necessary

- High probability of additional cracks not detectable by divers.
- Postponing repairs considered too high risk due to consequences of unplanned emergency closure at McAlpine.
- Risk of failure during “high water” season would have catastrophic impact upon wide

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Gate Problems

- LRL had just begun planning for fall 2005 dewatering inspection when May 2004 diving inspection revealed cracks in critical structural components of miter gate.
- Need for dewatering inspection and repairs accelerates to ASAP.

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Preparatory Measures: Public and Industry Coordination

- Primary issues raised:
  - Chemical industries unable to stockpile raw materials, due to lack of storage.
  - Aluminum and steel industries unable to stockpile sufficiently for extended closure, potential for plant shutdowns, layoffs, and even permanent closings

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Preparatory Measures: Public and Industry Coordination

- Primary issues raised:
  - Most industries preferred maximum advance notice.
  - Grain shippers concerned if closure went into September, due to harvest.
  - All extremely concerned that estimated two week closure could

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Preparatory Measures: Repair Planning and Preparation

- Diver inspections were performed every two weeks to monitor gate condition.
- Lead time allowed LRL to plan work, line up staffing, rent equipment and purchase materials.
- Two LRL planning teams formed. One for anticipated repairs in place, and second for gate change

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Preparatory Measures: Staffing

- Repair Crew of 106 was assembled, with emphasis on highly skilled welders.
- Work was scheduled continuously, on 2 – 12 hour shifts.
- Project Engineers and Safety Officers were assigned to each shift.

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Preparatory Measures: Equipment & Materials

- Modified anchor arms fabricated by contract for use on gate change contingency.
- Lock chamber was flushed.
- Replacement gates for lower end were prepared and loaded on Henry Shreve.
- Henry Shreve was positioned

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Scope of Work

- Dewater chamber.
- Clean and evaluate condition of problem areas on lower north gate.
- Confirm repair method and proceed.
- Re-weld and strengthen cracked areas.

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Scope of Work

- **Concurrently clean and inspect other gates and underwater components.**
- **Make other repairs as time allows; *not* to lengthen overall closure unless critical.**
- **Critical weld repairs to be**

Plate Reinforcing Repair Overview

- Reinforce U.S & D.S Lower Quoin/Pintle Area and D.S. Lower Miter End with ¾” Pre-Fab Plate
- Design plates to be installed easily in the field
- Cracks under plate will not be repaired unless deemed necessary by the Engineer.
- Irregular surfaces under plate areas to be ground smooth for plate to fit flush
- Clean and Blast areas of gate where plates will be welded

Plate Reinforcing Repair Overview (Cont.)

- Tack Weld plates to gate after positioning
- Following Weld Sequence shown on the plate drawings
- Check gap between Plate and Gate. Increase weld size if gap is > 1/16”
- Inspect Welds MT, VT
- Paint w/ Epoxy Primer
- Silicone Caulk around inside perimeter of joining surfaces

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Work in Progress

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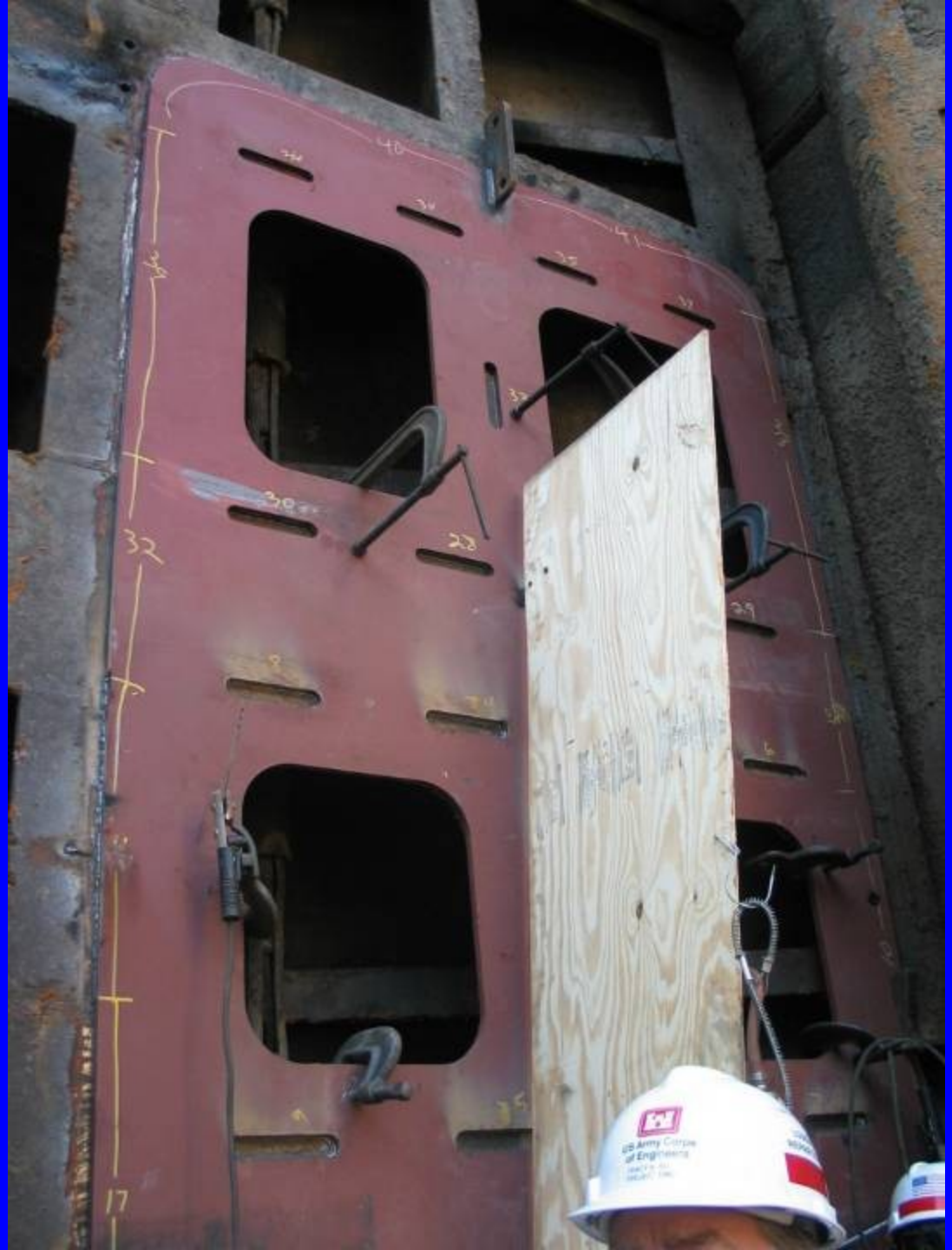
Work in Progress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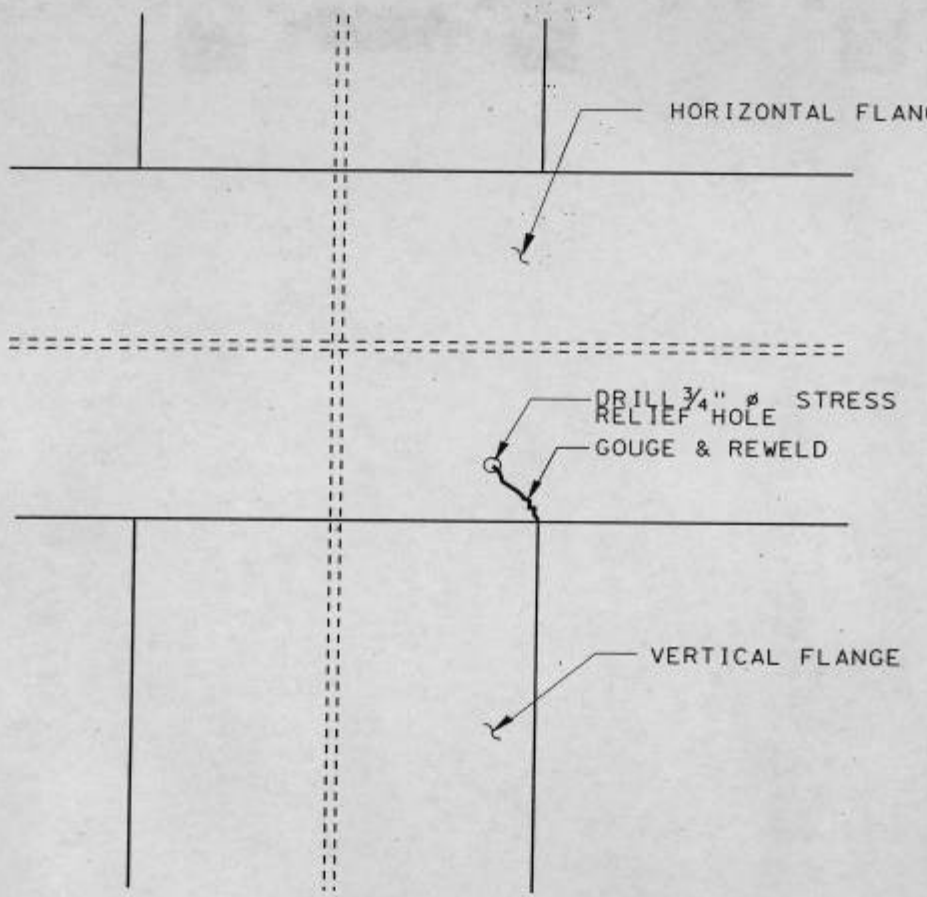
Crack Repair Overview

- Cracks will either be drilled at the tip or gouged and rewelded
- Inspectors will identify cracks and the repair procedure to be used
  - Drill Only
  - Gouge and Reweld
  - Gouge, Reweld and Grind Smooth
- In general, cracks > 3” will be gouged & rewelded. Cracks < 3” will be drilled only.
- Visually Inspect welds. Some repairs may be UT’d.

- Floating Crane
  - Lift Gates In / Out
  - Provision to Transport Gate Leaves

- Landside Storage Pier
  - An area to perform maintenance
  - Area to store spare gates



REPAIR PROCEDURE

1. CRACKS TO BE REPAIRED WILL BE MARKED BY THE ENGINEER.
2. LOCATE THE CRACK TIP USING VISUAL INSPECTION OR DYE PENETRANT.
3. DRILL A STRESS RELIEF HOLE AT THE CRACK TIP WITH A 3/4"ø BITT.
4. FOR CRACKS > 3" IN LENGTH GOUGE AND WELD CRACK. WELD SHOULD START AT THE EDGE OF HOLE AND PROCEED OUTWARD.
5. GRIND WELD SMOOTH.
6. FOR CRACKS < 3" . REWELDING IS NOT REQUIRED.

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MCALPINE LOCKS & DAM
WELD REPAIRS

C.W

Web Straightening and Repair

- Web buckling in critical areas need to be repaired
- Will probably require heat straightening or in a severe cases, plate replacement.
- Provide angle stiffeners to strengthen buckling capacity of the web

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Reopening August 19 (not August 22)

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Reopening

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Closing Observations

- Successful accomplishment attributed to intensive planning and advance preparation.
- Intense cooperation between LRL Engineering, Operations and Contracting provided the materials, equipment and expertise when needed.
- Availability of engineers on site 24 hours per day assured no delays or re-work when questions arose.

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Closing Observations

- **The Esprit de Corps during this job was incredible. Everyone realized the importance of the work and made their best efforts.**

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Questions or Comments?